A Literature Review on Chatbot Technology in the Health Care Sector

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Abstract

Chatbot is an emerging technology that helps in developing interactive systems. It is a software or computer program that simulates human conversation or "chatter" through text or voice interactions. Chatbots are used in different domains for different purposes. Chatbots allow humans to interact with the digital devices as if they were communicating with the real person. The paper aims at how chatbots could be used to help patients in the healthcare sector interact with the hospital with ease. The time taken to seek medical help should be reduced with the help of chatbots. Many chatbots offer services in the healthcare industry. The issue with these chatbots is that they can only respond to broad healthcare-related questions. The chatbot system for the healthcare industry is briefly discussed in this paper. Moreover, the paper discusses the different NLU(Natural Language Understanding), NLG(Natural Language Generation), and ML(Machine Learning) algorithms that should be used with the chatbot and evaluates them. This paper aims to introduce the role of chatbots in the healthcare sector and also understand the underlying architecture of chatbots. The paper explains the different types of chatbots and analyzes various chatbots used in health care systems. A SWOT analysis of the chatbot systems in the healthcare sector is evaluated. The paper also aims to identify the research gaps and future directions in contributing towards further study of chatbot technology in the healthcare sector. Various scholarly articles and websites are referred to and studied to gather information for this review paper. This review-based research article is a paper on chatbot technology to find the research objectives and the research gap in chatbot technology in the healthcare sector.

Keywords: chatbot, health care sector, NLP, NLU, NLG, ML algorithms, SWOT analysis

1. Introduction:

Chatbots are automated programs that mimic user behavior on one end of a chat session. These systems are imitations that imitate two-person conversations. They provide a virtual platform for effective and intelligent communications with the user on the other end. By imitating marketers, salespeople, counselors, and other mediators, they attempt to supply the services that the aforementioned professionals do. A few of the many industries that use chatbots are business, market, stock, customer service, healthcare, counseling, recommendation systems, support systems, entertainment, brokering, journalism, online food

and accessory shopping, travel, banking, recipe guides, and more [1]. The best examples of intelligent, communicative chatbots are the most well-known ones, such as Alexa or Google Assistant. These chatbots are general-purpose chatbots that provide services across all domains and are not restricted to a specific domain. Moreover, chatbots with specialized functionality for specific domains are available. Some examples of chatbots in various domains are as follows: Facebook users' data is collected by a chatbot known as Botsify, which further assists developers in constructing sophisticated Facebook Messenger chatbots.Imperson is a chatbot that assists developers in constructing conversations to assist companies and support customers.Newsreaders can more easily and quickly scan through the most significant headlines with the help of NBC, a chatbot [2]. All these chatbots help the users to develop the business and provide customer services.

The purpose of this study is to discuss the importance and application of chatbots in the healthcare industry. Numerous existing chatbots in the healthcare sector perform various functions. The following are chatbots used in the healthcare domain. A chatbot named Endurance assists individuals suffering from dementia disease.A chatbot named Casper helps those with insomnia get through the lonely nights when they are unable to sleep.Med What is a chatbot that delivers information about different diseases and their symptoms in addition to basic healthcare questions. The limitation of these chatbots is that they just deliver monotonous answers to users' questions. They are not capable of intelligent communication with the user in the same way that a computer is. This can be accomplished by putting in place a clever, perceptive chatbot that can converse with the user in the same way that a real person would. Conventional chatbots need to be equipped with NLU, NLG, and ML algorithms to behave like virtual buddies [3]. These methods improve the system's ability to communicate in natural language, are useful for counseling, and can also be modeled for the prediction of diseases.
Sixty percent of doctor visits are related to mild ailments, eighty percent of which can be cured at home with feasible home remedies, according to studies. Among these are typical ailments like the common cold and cough, headaches, and stomach problems. They may be caused by weather variations, eating an unhealthy diet, being exhausted, etc., and they can be managed without a physician's assistance.In other words, these algorithms cannot engage in natural dialog with users, unlike a doctor. Research is underway to enable chatbots to have conversations with each other that mimic two human speakers. Stated otherwise, the user needs to experience the interaction as if they are speaking with a real person instead of a machine. The chatbot thus serves as the user's virtual conversational buddy.By incorporating NLU(Natural Language Understanding), NLP(Natural Language Processing), and ML(Machine Learning) approaches into the traditional scripted chatbots, this kind of intelligent communication can be typically employed in the healthcare domain. The smart chatbots offer their functionalities in a variety of domains.

2. Objectives Of Review Paper:

The focus of this paper is based on the use of chatbots in the healthcare domain. The primary goal of the research is to enhance the patient satisfaction level in the medical healthcare systems with the implementation of chatbots. The following are a few of the objectives developed for our research.

- To introduce the role of chatbots in the healthcare sector
- To understand the underlying architecture of chatbots
- To explain the different types of chatbots
- Toanalyze the chatbots used in healthcare systems
- To evaluate the various approaches used in Chatbots
- To evaluate the chatbot systems using SWOT analysis
- To create a new framework for chatbots in the healthcare sector

- To identify the research gaps and future directions in contributing towards further study.

3. Methodology:

The suggested study employs a methodological approach to conduct a literature review on the subject. The data for the study was gathered from secondary sources such as journals, magazines, research articles, and books that could be freely available on the Internet. A comparison of the existing systems was carried out and the limitations of the existing systems were evaluated.

4. Review of literature/Related works:

This section focuses on the various chatbots that exist along with the area of focus and outcome of the research in that area.

Table1: Scholarly literatureonchatbot

S.No.	Area&FocusoftheResearch	The outcome of the research	Reference
1	Chatbot for elderly care	The machine learning algorithm used is LSTM	[4]
2	A trained chatbot for Medical Assistance	The types of knowledge used are structured databases	[5]
3	An Ergonomics Evaluation to Chatbot Equipped with Knowledge-Rich Mind	The language processing used is AIML	[6]
4	Bank Chatbot that is used as an intelligent assistant	The language processing technique used is NLTK	[7]
5	Online feedablechatbot	The language processing technique used is NLTK	[8]
6	Companion Chatbot that automatically generates questions	The language processing technique is the Stanford tool. The machine learning algorithm used is Logistic Regression	[9]
7	Automatic dialogue template generation for chatbot using Information Extraction	Language processing techniques used are CKIP and AIML	[10]

Table2: Scholarly literature on chatbots in the healthcare sector

S.No.	Domain oftheResearch	The outcomeof theResearch	References
1	Health care management	The use of chatbots is well accepted by educated patients and user adaptability is maintained	[11]
2	Medical Analysis	The chatbots create an awareness of the disease and provide satisfactory answers to user queries. The task performance of the chatbot is considered	[12]
3	Medical Assistant	Chatbots play an important role as assistants helping patients arrange appointments with the doctor and providing necessary information. They are weak in medical diagnosis.	[13]
4	Mental Well-being of the patient	Chatbots reduce anxiety in patients and assist in managing stress	[14]
5	Patient care	Chatbots reduce the loneliness of the patient by being positive	[15]
6	Patient Service	Chatbots can serve up to only 41% of the health-related responses. This could be a limitation of the chatbot	[16]

5. Analysis of Chatbot Technology in the Health :

A renewed interest in AI and advances in ML have led to the growing use and availability of chatbots in various fields. SmarterChild (ActiveBuddy, Inc) became widely accessible through messenger apps, followed by more familiar web-based assistants using voice-activated systems, such as Apple Siri, Amazon Alexa, Google Assistant, and Microsoft Cortana. The most popular developments of chatbots for healthcare purposes are diagnostics, patient support (ie, mental health counseling), and health promotion. Figure 1 below gives an overview of the different chatbots used in the healthcare sector.

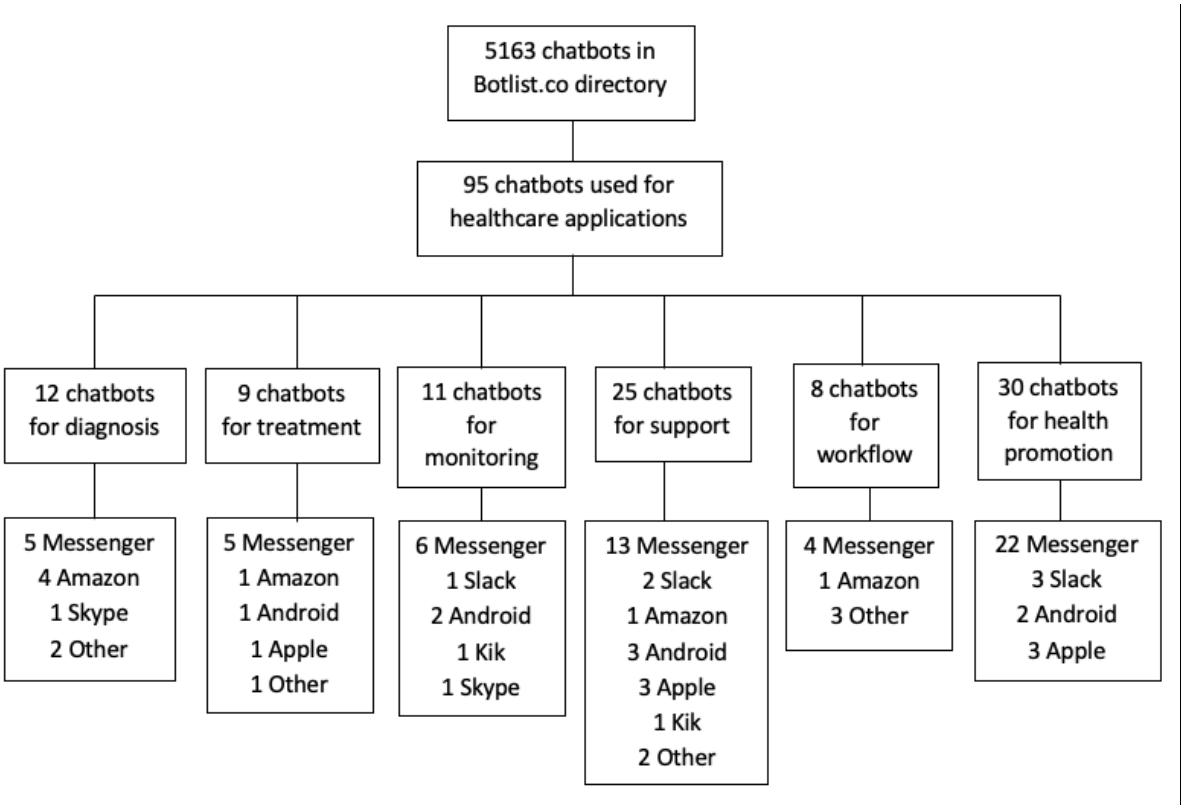

Figure 1: Types of Chatbots in the healthcare sector.

General Architecture of Chatbot:

Although there are a variety of techniques for the development of chatbots, the general layout is relatively straightforward. As a computer application that uses ML to mimic human conversation, the underlying concept is similar for all types with 4 essential stages (input processing, input understanding, response generation, and response selection). The following figure illustrates the simplified architecture of the chatbot. First, the user makes a request, in text or speech format, which is received and interpreted by the chatbot. From there, the processed information could be remembered, or more details could be requested for clarification. After the request is understood, the requested actions are performed, and the data of interest are retrieved from the database or external sources.

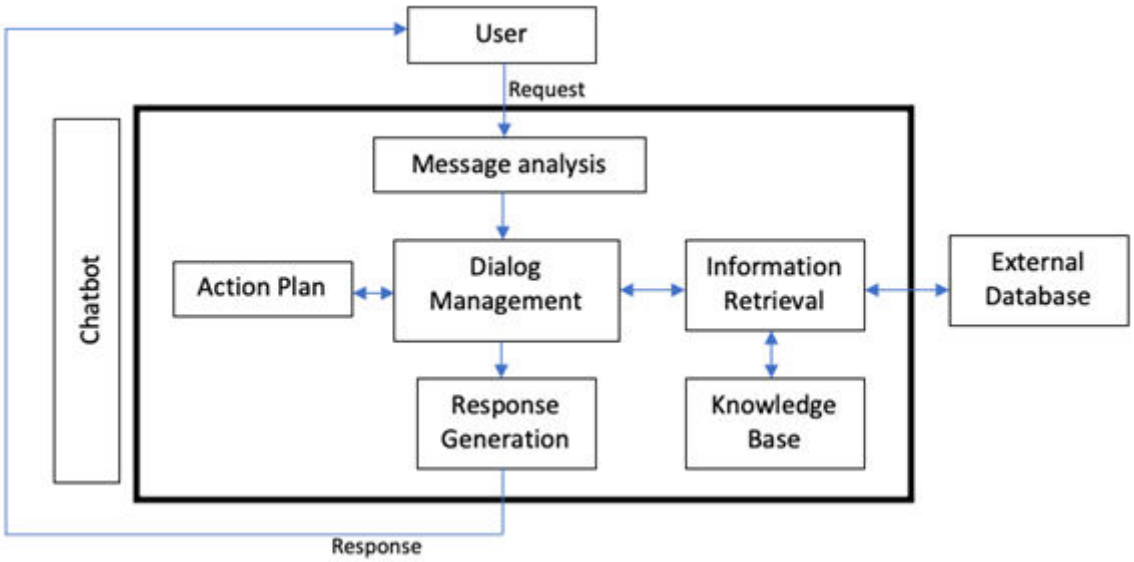

Figure 2: Simplified Architecture of Chatbot

6. Research Gap:

The potential research gaps in the healthcare chatbots are as follows:

1. Effective Diagnosis and Patient Health: Healthcare chatbots have shown their potential in a variety of applications; further study is required to evaluate their general efficacy and safety, especially in complicated medical situations. This involves evaluating their precision in identifying illnesses and offering medical guidance while minimizing the likelihood of erroneous diagnoses or patient injury.
2. User Acceptance: Understanding the user experience and acceptance of healthcare chatbots is crucial. Researchers can explore how patients and healthcare providers perceive and interact with chatbots, and what factors influence their willingness to use or trust these technologies.
3. Improve Personalization and Customization: It could be focused on improving the personalization and customization of chatbots to meet the needs of individual patients. Improvements in areas as to how to adapt chatbot interactions to a patient's specific health condition, preferences, and geographical background.
4. Integrate Chatbot with Health care systems: We could focus on examining the challenges and benefits of integrating chatbots into existing healthcare systems. This includes issues related to data privacy, interoperability with electronic health records, and regulatory compliance. We should ensure that chatbots adhere to healthcare regulations, maintain patient confidentiality, and address concerns such as liability and accountability.
5. Multi-modal Interaction: Research could be focused on exploring the potential benefits of integrating multi-modal interaction into healthcare chatbots. This helps the patients enhance their communication with the chatbot in text, video, or audio format thereby improving patient understanding and engagement
6. Cost-effectiveness and ROI: Research could be made to investigate the cost-effectiveness of chatbot and its return on investment. This could help healthcare providers to make informed decisions about resource allocation.
7. Chatbot-Provider Collaboration: Explore the potential for chatbots to collaborate with healthcare providers in a complementary manner. Research can assess how chatbots can assist healthcare professionals in their tasks and improve overall care quality.

8. Health Equity: Chatbots can address issues in health disparities and promote health equity. Research can focus on designing chatbots that are accessible to diverse populations and understanding their impact on reducing healthcare inequalities.
9. Support Mental Health: Chatbots could be designed to improve the overall mental health of patients. This includes evaluating their effectiveness in providing therapy, support, and interventions for mental health conditions.

7. SWOT Analysis on Chatbots :

Strengths:
There are many advantages of using chatbots in public health. A primary advantage of chatbots is their capacity to offer individuals tailored health information and assistance. People who might not be able to seek care during typical business hours can benefit from improved access to health information and support through Chatbots, which can be provided around the clock. Furthermore, chatbots can reliably and swiftly handle and analyze vast amounts of data, which can help with epidemic identification and disease surveillance. Chatbots can keep an eye out for indicators of new health risks, such as infectious disease outbreaks, on social media and other online platforms. They can also provide real-time information to individuals and healthcare providers about outbreaks in their area, which can help to prevent the spread of disease [17-19].

Weaknesses:
There are several drawbacks to the usage of chatbots in public health. One of the primary drawbacks is the possibility of misunderstandings or miscommunications since language models might not always correctly grasp the subtleties of context and human language. This could result in chatbots providing incorrect or misleading health information [20, 21]. Additionally, privacy is a concern, as chatbots may be vulnerable to hacking or data breaches, which can compromise sensitive health information. Furthermore, if the underlying data used to train the model is biased, there is the possibility that the chatbot will reinforce existing biases in health data. For example, if the data used to train the Chatbot is biased toward certain demographics, the chatbot may not provide accurate information to all populations[22].

Opportunities:
The employment of chatbots in public health has several opportunities. The potential for chatbots to give people individualized health information and help is one of the key benefits. This is particularly useful for individuals who may not have access to healthcare services or who may be hesitant to seek care due to stigma or other barriers [23]. To stop the spread of disease, chatbots can also aid in epidemic detection and disease surveillance. Chatbots can monitor social media and other online platforms for signs of new health concerns, such as epidemics of infectious diseases. They can also instantly alert the public and medical experts about epidemics occurring in their area. Another opportunity is that Chatbots can facilitate communication and collaboration between healthcare providers and patients, which can improve the quality of care and health outcomes [24].

Threats:
There are several risks associated with using chatbots in public health. One of the main risks is that chatbots could spread false or misleading health information. This can be a result of biased training data or mistakes in the language model's comprehension of human language and context. Additionally, as was already said, there is a chance that chatbots would maintain the biases that now exist in health data. Another danger is that chatbots may take the role of human connection and care, which would reduce

empathy and prevent personalized care from being provided. Finally, there is a chance that chatbots will widen the digital divide by excluding those without access to technology or who are uncomfortable utilizing it from Chatbot's public health advantages [25, 26].

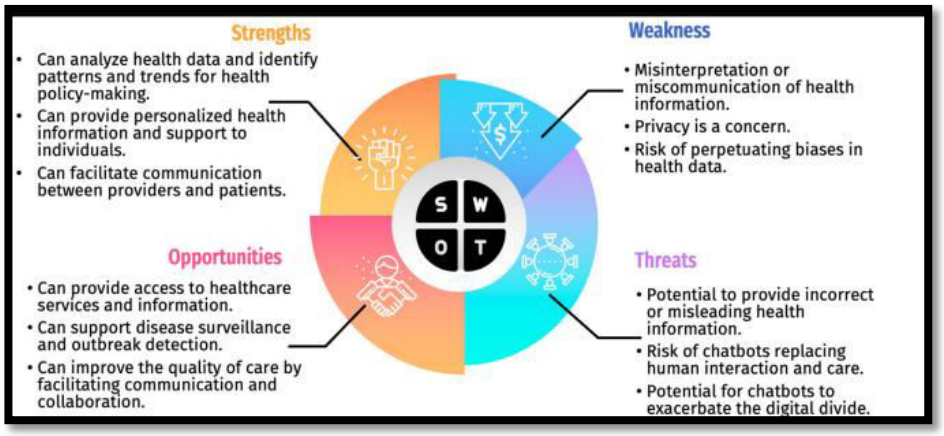

Figure 3: SWOT Analysis of Chatbots

8. Suggestions to Implement Research Activities According to the Proposal:

The following are the proposed research activities that could be performed in the domain of chatbots in the healthcare sector:

- Improve the chatbot's NLP capabilities to better understand and respond to user queries. This could be achieved by training the model with a diverse set of healthcare-related language data to enhance its contextual understanding.
- Implement personalized interactions based on user history, preferences, and health records. Tailor responses and recommendations to individual users, considering their specific health conditions and needs.
- Provide features for medication management, including medication reminders, drug interaction checks, and information about dosage and side effects. This can improve medication adherence among users.
- Integrate emergency response features, such as the ability to recognize urgent situations and guide users in seeking immediate medical attention. Include information on emergency contact numbers and procedures.
- Ensure the chatbot is accessible to users with disabilities. Implement features such as voice recognition, screen reader compatibility, and other accessibility enhancements.
- Implement strategies to enhance user engagement, such as push notifications for health reminders and personalized health goals.

9. Conclusion :

In conclusion, the integration of chatbots in the healthcare sector represents a promising and innovative approach to improving patient engagement, access to information, and overall healthcare outcomes. This paper has explored the various facets of deploying chatbots in healthcare settings and has identified both opportunities and challenges associated with this technology. The findings of this study underscore the potential of healthcare chatbots to enhance the delivery of medical information, support medication management, and offer personalized health guidance. The positive impact on patient education, empowerment, and adherence to treatment plans suggests that chatbots can play a significant role in augmenting traditional healthcare services. Although chatbots hold immense promise in transforming

healthcare delivery, a thoughtful and evidence-based approach is required to overcome challenges and maximize their potential benefits. With ongoing advancements and a commitment to ethical considerations, healthcare chatbots have the potential to become invaluable tools in supporting and augmenting the delivery of patient-centered care in the digital era.

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